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(54) Title: LUMINOUS UMBRELLA (57) Abstract <div style="display: flex;"> <div style="flex: 1;"> <p>The luminous umbrella of the present invention uses a high proportion of the light generated by mounting the light bulb (28) high on the shaft (22) such that most of the light from the light bulb is projected at the highly reflective undersurface (36). The curvature of the undersurface (26) focusses the light from the light bulb (28) down to illuminate a space immediately around the user. This illuminated space widens towards the bottom, thereby providing the widest illumination at the ground where it is most needed. As a result of the light being efficiently focussed, the required luminosity of the light bulb is reduced, enabling the umbrella to be used using an incandescent light bulb and a few 1.5 volt batteries (32). Alternatively, if it is desired to provide increased illumination, the conventional incandescent bulb (28) may be replaced with a halogen bulb. The batteries will still suffice to provide bright illumination by the halogen bulb. Preferably the bulb is retractable within a protective bulb housing (123) during non-use to mitigate the risk of breakage.</p> </div> <div style="flex: 1; text-align: center;"> </div> </div>		

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LUMINOUS UMBRELLA

Field of the Invention

5 The invention relates generally to umbrellas and more particularly to an energy-efficient luminous umbrella.

Background of the Invention

10 When it is raining, visibility is generally reduced, making it possible that people in the rain will fail to see obstructions such as puddles or curbs. This, in turn, increases the likelihood of accidental soakings, or falls and possible injury.

15 While prior luminous umbrellas have been devised, such luminous umbrellas are not suitable for providing illumination to a mobile user while it is raining. For example, United States Patent No. 2,087,537 (Finkel) discloses a garden umbrella having a light source that projects light upwardly. Some of the light projected upwardly is reflected by a disc mounted above the light. The light source receives electricity from an outlet via an extension cord; the umbrella is intended to be stationary during use.

20 United States Patent No. 3,275,815 (Petroff) discloses an umbrella in which a light is mounted in the end of a handle. The handle light projects light in a generally upward direction, some of the light being directed to the undersurface of the umbrella canopy. The fabric of the umbrella canopy is reflective with respect to some light and transparent with respect to other light so that both top and bottom surfaces of the umbrella canopy are
25 luminous. While some of the light from the handle light may provide useful illumination, most of the light is projected off into the distance where it is dissipated in the darkness and does not provide useful illumination in the vicinity of the user.

30 U.S. Patent No. 3,313,929 (Schiaivone) discloses a luminous umbrella having a tubular source of light contained within the uppermost part of the umbrella shaft, adjacent to the umbrella canopy. The tubular source of light projects light outwardly in both an upwards and

downwards direction. Some of the light that is projected upwardly shines through the umbrella canopy, causing the fabric to take on a subdued glow. Optionally, the umbrella canopy may be made partially reflective by applying a reflective coating, such as a paint containing dispersed aluminum particles. The Schiavone umbrella is stationary, requiring
5 electricity from an outlet to provide power for the light.

None of the foregoing umbrellas is suitable for providing illumination that enables mobile users to view their immediate surroundings while carrying the umbrella unfurled. In particular, the Finkel umbrella and Schiavone umbrella are intended to be stationary, and
10 require an outlet to power their respective lights. While the Petroff umbrella is portable, it may not provide sufficient illumination to enable users to view their immediate surroundings, as most of the light is lost as it is projected off into the distance or shines through the umbrella canopy.

15 Thus, a luminous umbrella that is portable and provides sufficient illumination to enable users to view their immediate surroundings, is desirable.

Summary of the Invention

20 An object of one aspect of the present invention is to provide a luminous umbrella that concentrates illumination from the light source in the vicinity of the user.

In accordance with the foregoing aspect of the invention, there is provided a closable luminous umbrella for illuminating an illuminated space proximate to the luminous umbrella.
25 The umbrella comprises a shaft, a collapsible canopy for sheltering the user, a handle mounted on the proximal end of the shaft, a light fixture, a power connection means and a light switch.

The collapsible canopy is mounted on a distal end of the shaft, and when opened has a highly reflective concave undersurface extending to an outer periphery to define a generally
30 circular concavity underneath the collapsible canopy. The handle is mounted on the proximal end of the shaft. The light fixture replaceably receives and orients a light source such that

when the light source is installed and operating and the umbrella is open, the light source faces the undersurface of the collapsible canopy, and is mounted on the shaft between the crest and the handle, so that most of the light from the light source is directed toward the ground when the open umbrella is in use in vertical orientation, either directly or by reflection from the undersurface of the collapsible canopy.

The power connection means is for connection to an integrable power source to integrally power the light source, thereby permitting the light source to operate during transportation. The light switch electrically connects and disconnects the light source and the integrable power source, thereby turning the light source on and off.

Preferably, light fixture comprises a bulb fixture for removably receiving a replaceable bulb, and a bulb housing mounted on the shaft within the concavity defined by the undersurface of the collapsible canopy when the umbrella is open. The bulb fixture is preferably mounted in the bulb housing such that the bulb fixture is retractable into the bulb housing in order to protect the bulb during non-use, and is extendable out of the bulb housing during use to enhance illumination.

Brief Description of the Drawings

A detailed description of the preferred embodiments is provided herein below with reference to

Figure 1 that, in a sectional schematic view, illustrates a luminous umbrella constructed in accordance with an embodiment of the present invention;

Figure 2 that, in an elevation view, illustrates a luminous umbrella in accordance with a preferred embodiment of the present invention;

Figure 3 that, in a sectional view, illustrates the bulb housing of the luminous umbrella of Figure 2 with the bulb retracted;

Figure 4 that, in a sectional view, illustrates the bulb housing of the luminous umbrella of Figure 2 with the bulb protruding;

Figure 5 that, in a sectional view, illustrates the retraction controller of the luminous

umbrella of Figure 2;

Figure 6 that, in an end view, illustrates retraction controller of the luminous umbrella of Figure 5;

Figure 7 that, in a side view partially in section, illustrates the bulb housing and
5 umbrella tip of the luminous umbrella of Figure 2;

Figure 8, that, in a side view, illustrates the bulb fixture of the luminous umbrella of Figure 2;

Figure 9, that, in a side view orthogonal to the side view of Figure 8, illustrates the bulb fixture of the luminous umbrella of Figure 2;

Figure 10, that, in an end view, illustrates the bulb fixture of the luminous umbrella
10 of Figure 2;

Figure 11 that, in a sectional view, illustrates the umbrella tip of the luminous umbrella of Figure 2;

Figure 12 that, in an exploded side view orthogonal to the side view of Figure 7,
15 illustrates the bulb housing and umbrella tip of the luminous umbrella of Figure 2;

Figure 13 that, in an exploded end view, illustrates the bulb housing of the luminous umbrella of Figure 2.

Detailed Description of the Preferred Embodiments of the Invention

20 Referring to Figure 1, there is illustrated in a sectional view, a luminous umbrella 20 in accordance with a preferred embodiment of the invention. The luminous umbrella 20 includes a shaft 22 and a collapsible canopy 24. The collapsible canopy 24 is mounted at the distal end of the shaft 22. When open, the collapsible canopy 24 extends radially outwardly
25 and also downwardly (as viewed in Figure 1, which illustrates the normal open position of the umbrella 20) from the crest 23 to define a concavity underneath the collapsible canopy. The canopy 24 has a generally circular symmetry about the shaft 22, but the usual strengthening ribs normally found in association with umbrella canopies may be provided also as required.

30 The collapsible canopy 24 has a highly reflective undersurface 26. In the embodiment shown, the collapsible canopy 24 is deeply curved in that when the umbrella 20 is open

(open), the outermost part of the collapsible canopy 24 extends downwardly at a constant radial distance from the shaft 22, or even slightly inwardly towards the shaft 22, such that most of the light shone on any part of the reflective undersurface 26 is focussed to concentrate the illumination underneath the canopy 24.

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A light bulb 28 is mounted on the shaft 22 between the handle 30 and the crest 23 of the collapsible canopy 24, and faces the undersurface 26 such that much of the light from the light bulb 28 is projected at the undersurface 26. In the embodiment of Figure 1, the light bulb 28 is within the concavity defined by the undersurface 26; therefore, apart from a minor amount of light striking the shaft 22, which can also be reflective in the vicinity of the light source 28 (see discussion below), the remaining light that is not projected onto the undersurface 26 is projected underneath the collapsible canopy 24.

Preferably, the shaft 22 is reflective proximate to the bulb 28 to reflect light that is projected at the shaft 22. The light bulb 28 is shielded from water by a bulb case 36. The reflective undersurface 26 is preferably a silver or white colour and has an extremely high luminous reflectance such that most of the light from the light bulb 28 is reflected by the undersurface 26. The shaft 22, at least in the vicinity of the light source 28, may also be of reflective silver or white colour. Due to the shape and orientation of the undersurface 26, resulting from the deep curvature of the canopy 24, the light that is reflected by the undersurface 26 of the collapsible canopy 24 is focused primarily underneath the collapsible canopy 24 such that relatively little light is projected radially far beyond the collapsible canopy 24. Of course, the focussing of the light provided by the undersurface 26 is diminished as the distance from the undersurface 26 increases, so that light that is projected radially beyond the collapsible canopy 24 is typically concentrated on the ground, thereby illuminating the ground around the user of the umbrella to enable the user to notice puddles or other obstacles.

The undersurface 26 can be made reflective by applying a reflective coating to a substantially opaque collapsible canopy 24. Preferably, however, the undersurface 26 is made reflective by attaching a film or sheet of highly reflective material to the underside of the

collapsible canopy 24. The outer layer of the collapsible canopy 24 preferably comprises a substantially opaque and waterproof fabric.

In the embodiment shown in Figure 1, the shaft 22 has a handle 30 at its proximal end. The handle 30 includes an end cap 40 that is removable to permit batteries 32 to be inserted into a housing 46 within the handle 30. The batteries 32 are connected to the light bulb 28 via conductors 38. When a push-button 44 is pressed, the circuit between the batteries 32 and light bulb 28 is opened or closed thereby turning the light on and off. The push-button 44 is sealed to prevent leakage of moisture into the housing 46.

The combination of the feature that the light bulb 28 is mounted within the concavity so that most of the light is projected at the undersurface 26, together with the feature that the undersurface 26 of the collapsible canopy 26 is deeply curved and has a very high luminous reflectance, results in the light from the light bulb 28 being focused down to illuminate a space immediately around the user. This luminous space widens towards the bottom, thereby providing the widest illumination at the ground where it is most needed. As a result of the light being very efficiently focused, the required luminosity of the light bulb is greatly reduced, enabling the umbrella to be used for several hours using an incandescent light bulb and just three 1.5 volt batteries. Alternatively, if it is desired to provide extremely bright illumination, the conventional incandescent bulb may be replaced with a halogen bulb. The three 1.5 volt batteries still suffice to provide bright illumination by the halogen bulb for more than an hour, using commercially available dry cell batteries.

In order to minimize impairment of the user's night vision, the light bulb 28 may provide red-light only, or the light may include a red-light source (or a red filter) and a white-light source, in which case the light source is switchable between a red-light setting for improving the visibility of the user and the ground in while minimizing impairment of night vision, and a white-light setting suitable for greatly improving the visibility of the user and the ground.

Referring to Figure 2, there is illustrated in an elevation view, a luminous umbrella 120

in accordance with a second preferred embodiment of the invention. The luminous umbrella 120 includes a shaft 122 and a collapsible canopy 124. The collapsible canopy 124 is mounted at the distal end of the shaft 122. The collapsible canopy 124 extends radially from the shaft 122 to define a concavity underneath the collapsible canopy. The collapsible canopy 124 has a highly reflective undersurface 126. In this embodiment, the collapsible canopy 124 has a relatively shallow curvature.

Referring to Figures 3 and 4, a bulb housing 123 is shown isolated from the other elements of the umbrella of Figure 2; in the umbrella 120, the bulb housing 123 is mounted on the shaft 122. In Figure 2, the bulb housing 123 cannot be seen as it is mounted on the shaft 122 by housing screws 152 just under the collapsible canopy 124. The bulb housing 123 has a bulb fixture 129 for receiving a light bulb 128 and a sleeve 119, radially spaced from the shaft 122 (not shown in Figure 3 and 4) for internally receiving a slidingly mating bulb retraction controller piston 127. The bulb fixture 129 is biased to a retracted position within the bulb housing 123 by a fixture spring 146. The retraction controller piston 127 annularly surrounds the shaft 122 (not shown in Figure 3 and 4) and protrudes through a control aperture 156 of the sleeve 119 towards the handle 130 (also not shown in Figures 3 and 4). The truncated conical element 147 connects to an umbrella tip 160 (shown in Figures 7 and 12) beyond the collapsible canopy 124. The retraction controller 127 is held in the bulb housing 123 by a shoulder 158 that cannot pass through the control aperture 156 of the bulb housing 123. The retraction controller piston 127 is biased by a retraction control return spring 142 to protrude beyond the control aperture 156 to the maximum extent possible, as determined by the position of the shoulder 158 on the retraction controller piston 127. Within the bulb housing 123, the retraction controller piston 127 has at its inner end a bulb extending control finger 117 having distally an inclined cam surface 148 that is contiguous with a mating inclined cam surface 150 on the seat 154 of the bulb fixture 129, such that if the retraction controller piston 127 is forced into the bulb housing 123, thereby compressing the control return spring 142, the action of cam surface 146 against cam surface 150 forces a radially outward movement of the bulb fixture 129, thereby compressing the fixture spring 146 and extending the light bulb 128 outwards into illuminating position through bulb aperture 136 formed in sleeve 119.

The foregoing mechanism has been designed to cooperate with existing elements of conventional umbrellas so as to retract the light bulb 128 when the umbrella is closed and to extend the light bulb 128 into illuminating position when the umbrella is open. This interaction with conventional furling/unfurling action is described in the following paragraph.

5

Conventionally, umbrellas may be opened by sliding an annular strut support up the shaft (away from the handle) and may be closed by sliding an annular strut support down the shaft (toward from the handle). The annular strut support receives one end of each of the struts, the other end of each of the struts helps to support the umbrella canopy in the open position when the annular strut support is slid up the handle, and pulls the umbrella canopy into the closed position when the annular strut support is slid down the handle. It is conventional to include a locking mechanism in the umbrella for holding the umbrella open or closed by, respectively, holding the annular strut support in a advanced position, away from the handle, or in a rest position, proximate to the handle. The embodiment of Figure 2, 3 and 4 includes this conventional feature, and utilizes it to project the light bulb 128 out of the bulb housing 123 when the annular strut support is in the advanced position and the umbrella is thereby opened. In the advanced position, as shown in Figure 4, the annular strut support will have contacted the retraction controller piston 127, and will have pushed the retraction controller 127 into the bulb housing 123, thereby overcoming the resistance of the fixture spring 146 and the retraction control spring 142, to project the light bulb 128 out of the bulb aperture 136. As shown or described in Figure 3, when the annular strut support is moved toward the handle 130 from the advanced position, it is moved away from the retraction controller piston 127, which will, as a result of the biasing provided by the retraction control return spring 142, extend maximally out of the sleeve 119, and the bulb fixture 129 will, as a result of the biasing provided by the bulb fixture return spring 146, be retracted within the bulb housing 123.

Referring to Figures 7, 12 and 13, the bulb housing 123 is illustrated in isolation from retraction controller piston 127 and the bulb fixture 129. The bulb housing 123 is secured about the shaft 122 by shaft posts 164 and housing screws 152. Referring to Figures 5 and 6, the retraction controller piston 127 is illustrated in isolation from the bulb housing 123. The retraction controller piston 127 has a retraction control track 166 that surrounds the shaft posts

30

164, permitting the retraction controller piston 127 to move axially relative to the shaft 122 and the bulb housing 123 within limits defined by the retraction control track 166.

Figures 7 and 13 also illustrate an umbrella tip 160, a cross-sectional view of which is shown in Figure 11, and a rib support 172, secured to the umbrella tip 160 by a rib support fastener 174. The rib support 174 is dimensioned to secure the ribs of the canopy radially spaced from the umbrella tip 160 to reduce buckling of the ribs about the bulb housing 123.

The ribs themselves are preferably designed to permit some buckling of the ribs about the bulb housing 123 when the umbrella 120 is closed without placing significant compressive forces on the bulb housing 123.

Figures 8, 9 and 10 illustrate the bulb fixture 129 of the luminous umbrella in isolation from the bulb housing 123. The bulb fixture comprises fixture guide ribs 168 dimensioned to slide within a mating fixture control track 162 of the bulb housing 123, illustrated in Figure 7, thereby constraining the direction of the path of travel of the bulb fixture 129 and light bulb 128 relative to the bulb housing 123 during retraction and extension. The bulb fixture 129 also comprises terminals 170 for receiving power for the light bulb 170.

The bulb housing 123 is reflective to reflect light that is projected at the shaft 22. The reflective undersurface 126 is made of a highly reflective (*e.g.*, silvered) material attached to the underside of the collapsible canopy 124. The collapsible canopy 124 comprises a substantially opaque and waterproof fabric to occlude residual light that shines through the reflective material. Due to the curvature of the undersurface 126, the light that is reflected by the undersurface 126 of the collapsible canopy 124 is focussed primarily on the area underneath the collapsible canopy 124. Of course, the focussing of the light provided by the undersurface 126 is diminished as the distance from the undersurface 126 increases, so that it is at the ground that light is projected radially beyond the collapsible canopy to the greatest extent. This illuminates the ground around the user of the umbrella to enable the user to notice puddles or other obstacles.

As with the embodiment of Figure 1, in the embodiment of Figure 2, the shaft ends in

a handle 130. The handle 130 includes an end cap 134 that is removable to permit four 1.5V batteries to be inserted into a battery housing within the handle. The batteries are connected to the light bulb via conductors. When a push-button on the handle 130 is pressed, then the circuit between the batteries and light bulb is opened, if previously closed, or closed, if previously open, thereby turning the light off or on respectively. The push-button is sealed to prevent leakage of moisture into the battery housing.

Modifications and variations will be apparent to those skilled in the art. Specifically, in an alternative embodiment, the handle comprises a rechargeable battery that is intended to remain within the handle when being recharged, and an electrical inlet for receiving electricity to recharge the battery. In another embodiment, the light is provided by a light source that includes light control means for changing the width of the light emitted between a wide-beam setting and a narrow-beam setting. On the wide-beam setting, the light source illuminates a larger space around the user; on the narrow-beam setting, illumination is radially confined to a space immediately surrounding the user. The light source is switchable between the wide-beam setting and the narrow-beam setting by the light actuator. Accordingly, the invention is as defined in the claims.

WHAT IS CLAIMED IS:

1. A closable luminous umbrella for illuminating an illuminated space proximate to the luminous umbrella, comprising
 - 5 (a) a shaft;
 - (b) a collapsible canopy mounted on a distal end of the shaft for sheltering the user, the collapsible canopy having, when open, a highly reflective concave undersurface extending to an outer periphery to define a generally circular concavity underneath the collapsible canopy;
 - 10 (c) a handle mounted on the proximal end of the shaft;
 - (d) a light fixture for replaceably receiving and orienting a light source such that when the light source is installed and operational and the umbrella is open, the light source
 - (i) faces the undersurface of the collapsible canopy, and
 - (ii) is mounted on the shaft between the crest and the handle,
 - 15 such that most of the light from the light source is directed toward the ground when the open umbrella is in use in vertical orientation, either directly or by reflection from the undersurface of the collapsible canopy;
 - (e) a power connection means for connection to an integrable power source for integrally powering the light source to permit the light source to operate during
 - 20 transportation;
 - (f) a light switch electrically connected between the light source and the integrable power source for turning the light source on and off.
2. An umbrella as defined in claim 1 wherein the light fixture is oriented on the shaft such

that the light source, when mounted and operational, is within the concavity defined by the undersurface of the collapsible canopy when open such that most of the light from the light source is projected onto the reflective undersurface of the open collapsible canopy.

5 3. An umbrella as defined in claim 2 wherein the open collapsible canopy is curved such that substantially all of the reflected light is focussed to be concentrated underneath the collapsible canopy.

10 4. An umbrella as defined in claim 2 wherein, when the umbrella is open, the collapsible canopy is deeply curved to extend substantially parallel to the shaft at the outer periphery, thereby focussing substantially all of the light reflected by the undersurface to underneath the collapsible canopy.

15 5. An umbrella as defined in claim 2 wherein the umbrella comprises a power supply receptacle for replaceably receiving batteries, the batteries in the power supply receptacle being in electrical communication with the light fixture via the power connection means.

20 6. An umbrella as defined in claim 1 additionally including a dimmer associated with the light source for controllably brightening and dimming the light from the light source.

7. An umbrella as defined in claim 6, wherein the dimmer is incorporated into the light switch.

8. An umbrella as defined in claim 1 wherein the light source is a composite light source having a plurality of constituent coloured light sources.
9. An umbrella as defined in claim 8, wherein the coloured light sources comprise
- 5 (a) a red-light source for improving the visibility of the user and the ground in the luminous space while minimizing impairment of night vision; and
- (b) a white-light source suitable for improving the visibility of the user and the ground in the illuminated space underneath the open canopy.
- 10 10. An umbrella as defined in claim 2 additionally comprising (i) an adjustable director for changing the direction of the light provided by the light source, the adjustable director having a wide-beam setting for radially extending the illuminated space underneath the open canopy, and a narrow-beam setting for radially confining the illuminated space underneath the open canopy; and (ii) a reflector control switch for switching the adjustable director between the
- 15 wide-beam setting and the narrow-beam setting.
11. An umbrella as defined in claim 10, wherein the director control switch is incorporated into the light switch.
- 20 12. An umbrella as defined in claim 2 wherein the light fixture comprises
- (a) a bulb fixture for removably receiving a replaceable bulb;
- (b) a bulb housing mounted on the shaft within the concavity defined by the undersurface of the collapsible canopy when the umbrella is open,

wherein the bulb fixture is mounted in the bulb housing such that the bulb fixture is retractable into the bulb housing in order to protect the bulb during non-use, and is extendable out of the bulb housing during use to enhance illumination.

5 13. An umbrella as defined in claim 12 wherein the bulb fixture is movably mounted in the bulb housing and the bulb housing comprises a retraction means for

(i) automatically extending the bulb fixture from the bulb housing when the umbrella is open,

10 (ii) automatically retracting the bulb fixture into the bulb housing when the umbrella is closed.

14. An umbrella as defined in claim 13 wherein

15 (a) the retraction means comprises a retraction controller biased to project out of the bulb housing toward the handle, the retraction means cooperating with the bulb fixture so as to retract the bulb fixture to within the bulb housing when the retraction controller projects out of the bulb housing toward the handle; and,

(b) the bulb fixture is extended only when the retraction controller is forced into the bulb housing .

20 15. An umbrella as defined in claim 14 further comprising

(a) a plurality of ribs extending radially from the central crest of the collapsible canopy to the periphery;

(b) a rib support mounted about the shaft at the central crest for securing the plurality

of ribs to the shaft;

(c) a strut support slidably mounted about the shaft;

(d) a plurality of struts, each of the plurality of struts extending between

(i) a distinct associated rib of the plurality of ribs to provide support for such
distinct associated rib when the umbrella is open;

(ii) the strut support;

wherein

(e) the retraction controller is actuated by being forced further into the bulb housing;

(f) the strut support is slidable between

a relaxed position wherein the umbrella is closed and the strut support is spaced
from the retraction controller such that the retraction controller is unactuated and the
bulb fixture is retracted, and

a support position proximate to the bulb housing wherein

(i) the umbrella is open,

(ii) the strut support contacts and actuates the retraction controller by forcing the
retraction controller further into the bulb housing, thereby extending the bulb
fixture, and

(iii) each of the plurality of struts supports the distinct associated rib of the
plurality of ribs, thereby supporting the collapsible canopy.

16. An umbrella as defined in claim 14 wherein the plurality of ribs are radially spaced
from the shaft at the rib support to mitigate buckling of the plurality of ribs about the light
source and to reduce compression of the bulb housing by the plurality of ribs when the

umbrella is closed.

17. An umbrella as defined in claim 14 wherein the plurality of ribs are flexible to facilitate buckling of the ribs around the bulb housing, and to minimize compression of the bulb housing by the ribs.
18. An umbrella as defined in claim 14 wherein the power source comprises batteries replaceably contained in the handle.
19. An umbrella as defined in claim 14 wherein the power source comprises a built-in rechargeable battery in the handle.
20. An umbrella as defined in claim 14 wherein the collapsible canopy comprises two overlapping layers, viz a reflective under-layer having an exterior reflective surface and a substantially opaque and waterproof over-layer.
21. An umbrella as defined in claim 14 wherein the exterior reflective surface of the reflective under-layer has a silver colour.
22. An umbrella as defined in claim 14 wherein the exterior reflective surface of the reflective under-layer has a white colour.

23. An umbrella as defined in claim 9 wherein the shaft comprises a reflective portion proximal to the light source for reflecting light projected onto the shaft.

1/4

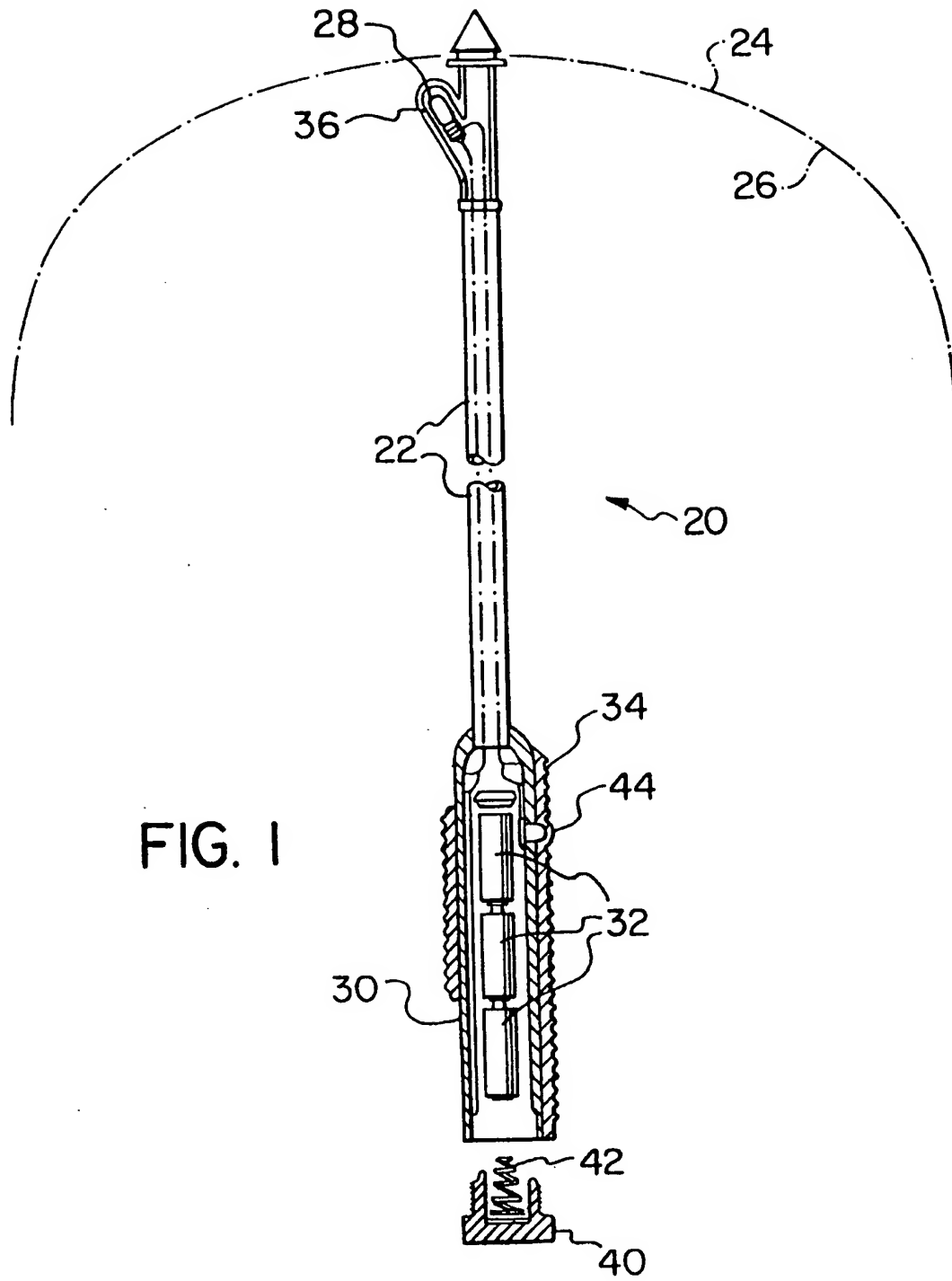


FIG. 1

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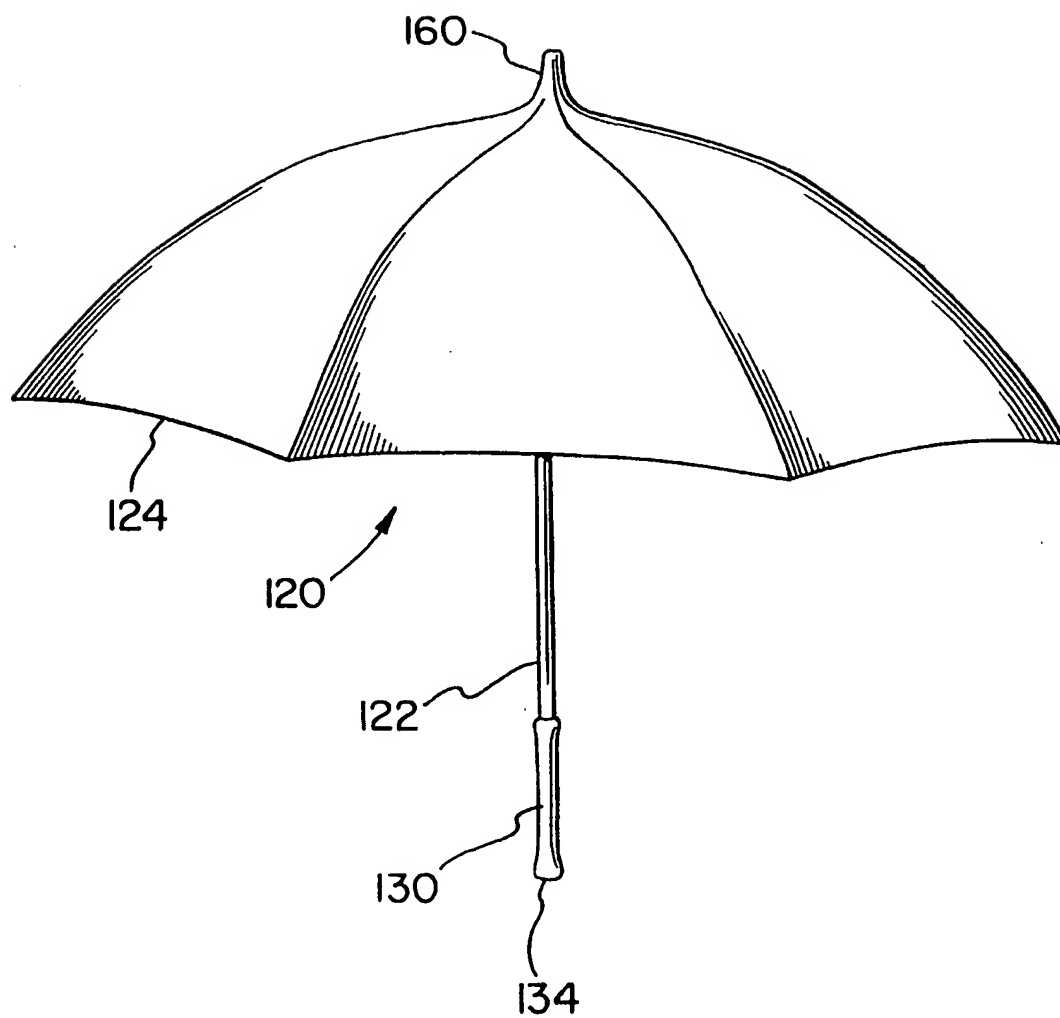
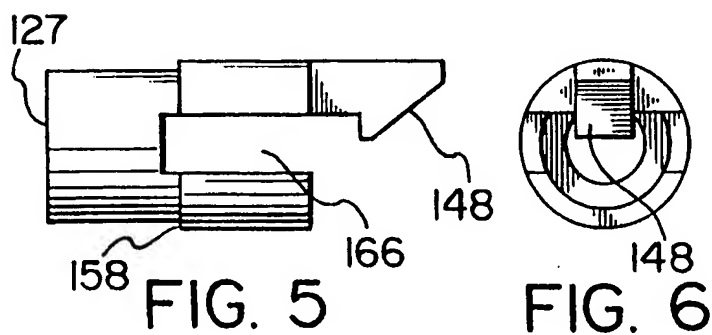
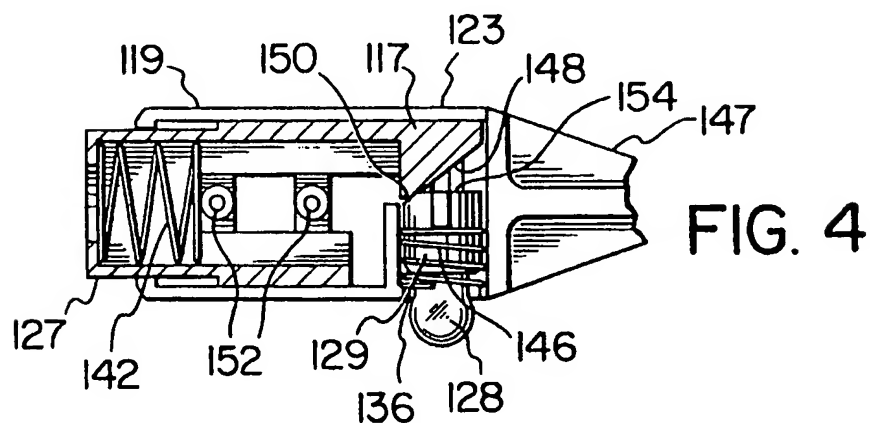
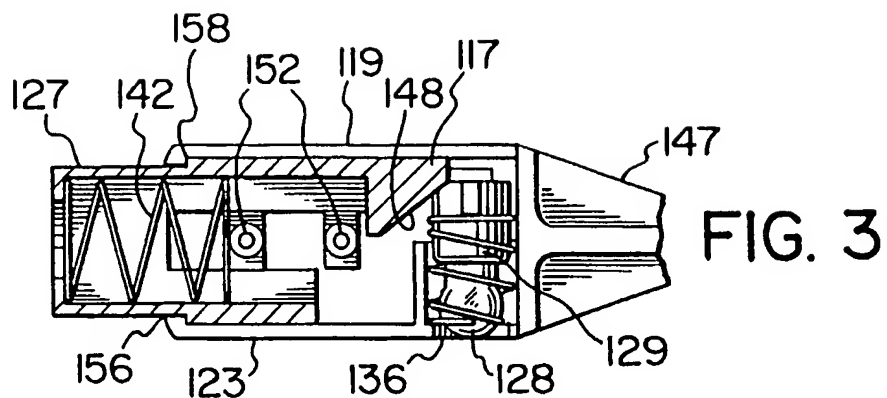


FIG. 2

3/4



4/4

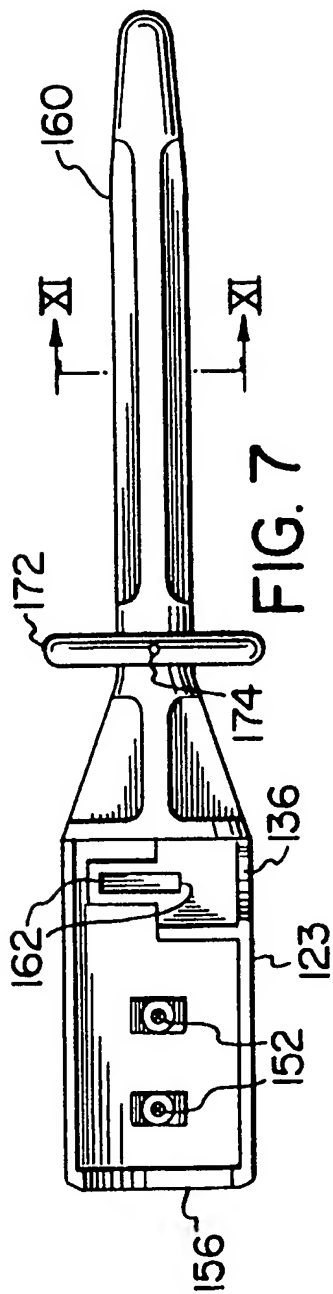


FIG. 7

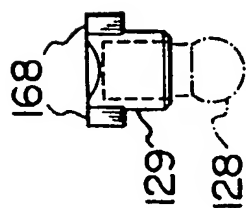


FIG. 8

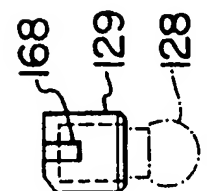


FIG. 9

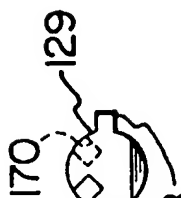


FIG. 10



FIG. 11

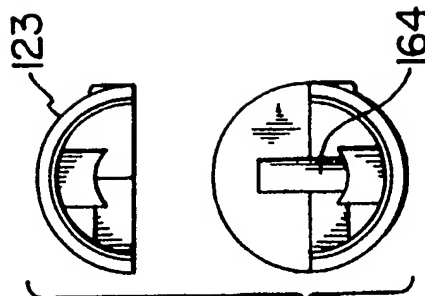


FIG. 12

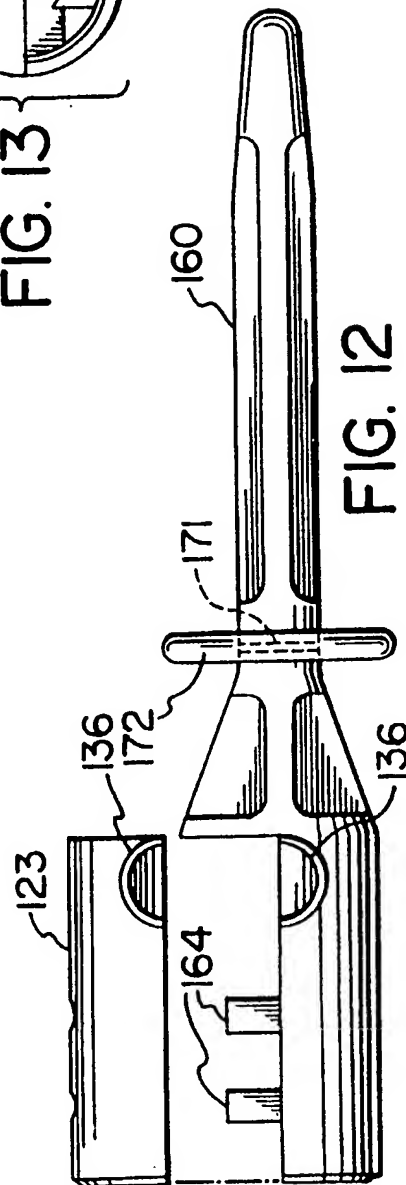


FIG. 13

INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 98/00446

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A45B3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A45B F21V F21P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	GB 2 052 037 A (GARD E) 21 January 1981. see claim 16; figures see page 1, line 78 - line 85 see page 2, line 18 - line 24 see page 2, line 82 - page 3, line 65 ---	1-5, 8, 10 12, 13, 15-18, 20-22
X A	US 3 275 815 A (GOLAZ A. M.) 27 September 1966 cited in the application see figures 3, 6, 7 see column 1, line 45 - line 61 see column 2, line 8 - line 39 see column 2, line 51 - column 3, line 5 --- -/--	1-5, 8, 10 12, 13, 15-19, 23

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

11 August 1998

Date of mailing of the international search report

19/08/1998

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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X A	US 5 126 922 A (ANDREASEN IB R) 30 June 1992 see abstract; figure 1 see column 2, line 3 - line 12 ---	1,2,5,8 3,4,12, 15-18,23
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International Application No
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